Michigan Carbon Rule Modeling Basics

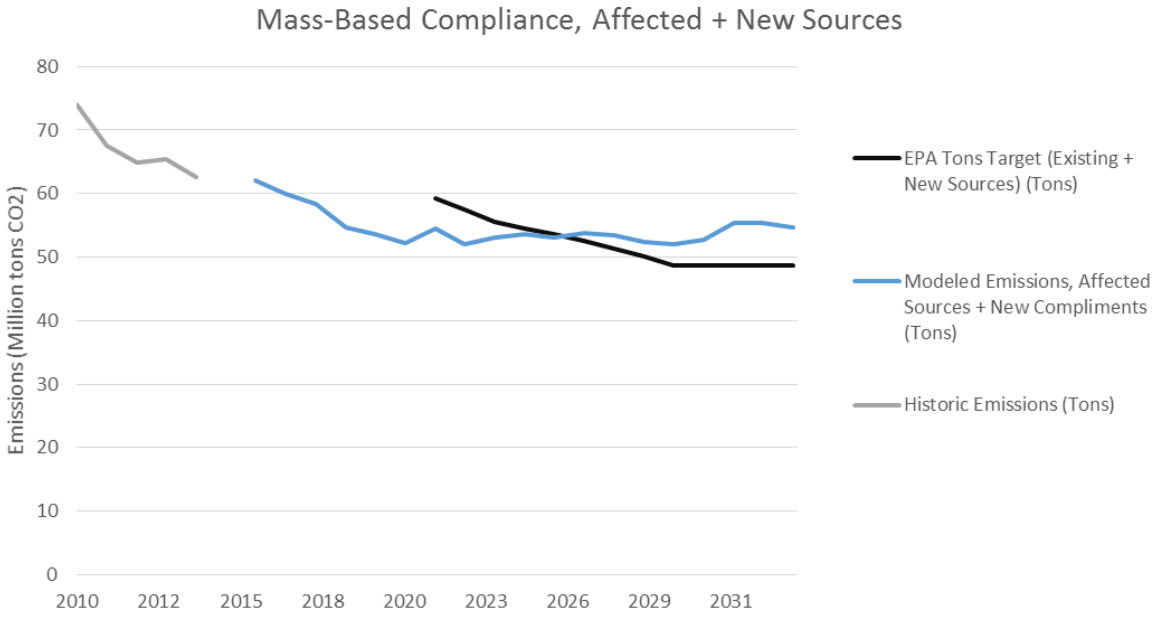
To fully understand the state's carbon reductions across the electric utility sector and the various potential compliance options to address those carbon reductions, the State of Michigan decided to perform detailed modeling and analysis on its electric generation fleet. The initial phase of the modeling effort established a base case for carbon emissions from the electric generation units (affected fossil fueled units) identified by the EPA carbon rule. A consultant was hired (Synapse Energy Economic, Inc.) to perform model runs analyzing future carbon emissions from Michigan's electric generation fleet, absent the carbon rule requirements. The base case used a variety of inputs and assumptions, such as forecasted load growth, fuel prices (coal, natural gas, oil, etc.), generation resource costs, as well as other elements. The analyses also incorporated the effects of waste reduction and provided results in the form of an optimized portfolio of Michigan electric generation resources necessary to meet future load requirements.

Base-Case Compliance Approaches

Two (2) baseline model runs were performed, one reflecting a mass-based compliance approach and one as a rate-based compliance approach. The 2 baseline model runs assumed that the carbon rule requirements do NOT impact Michigan's generation units. The model selected new generation resources (such as natural gas combined cycle or simple cycle combustion turbines, wind and solar) to fill electric capacity shortfalls due to unit retirements or system load growth. Load growth was assumed to be a constant 1.2%/year for the study period (years 2016 – 2034) adjusted by an annual 1% reduction due to ongoing energy waste reduction programs.

Base Case: Mass-Based Compliance Approach

The baseline results for a mass-based compliance approach show a reduction of carbon emissions from the 2012 base year (EPA chose 2012 as the base year for emissions calculations) due to the impact of coal plant retirements, additional waste reduction and increased use of existing natural gas fired generation. The slide below shows that the baseline case CO2 emissions meets or exceeds the carbon rule emission reduction requirements on a **mass basis** for carbon through 2026, which is beyond the initial compliance period of 2022-2024. During the final compliance period (2032-2034) a reduction of roughly 6.5 million tons annually would be required to meet the final mass-based EPA standard. Meeting the standard would require the addition of reduced carbon emitting resources to the resource mix to replace the emissions from existing fossil fueled facilities. To provide perspective, a reduction of 6.5 million tons would be roughly equivalent to the addition of 4,000 MWs of new natural gas fired generation or 3,000 MWs of new wind generation.



Emissions Gap:

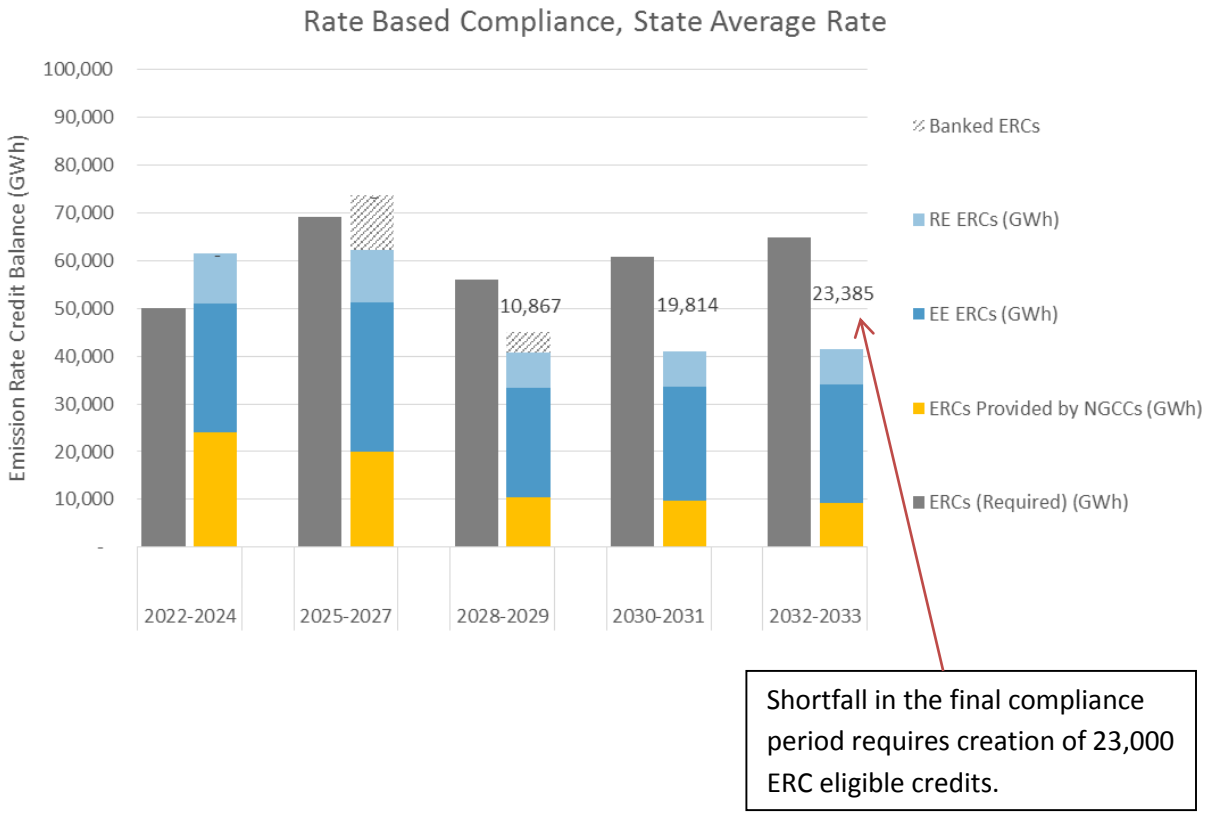
2022	2023	2024	2025	2026	2027	2028
(4.7)	(5.4)	(2.4)	(0.9)	(0.5)	1.2	

2029	2030	2031	2032	2033	2034
2.4	3.4	4.2	6.7	6.8	6.1

~6.5 million tons of annual emission reductions required.

Base Case: Rate-Based Compliance Approach

The system was also modeled under the rate-based approach. The results indicate that compliance is more difficult to achieve under a rate-based approach. Similar to the mass-based case, the slide below shows that the baseline case CO2 emissions meets or exceeds the CPP emission reduction requirements for carbon on a **rate basis** during the initial compliance period (2022-2024) and beyond. However during the final compliance year, the creation of 23,000 emission rate credits (ERCs) would be required in order to meet the rate-based EPA standard.



Carbon Rule Compliance Modeling Scenarios

The current modeling effort is continuing to evaluate various compliance scenarios for rate and mass-based approaches. After establishing the baseline scenarios, the Michigan Carbon Team (MAE, MDEQ and MPSC), assisted by a Technical Advisory Team (comprised of external stakeholders with modeling expertise), established a number of compliance scenarios to model. These scenarios were designed to help develop an effective and least cost State compliance strategy which will guide the development of the initial State Plan. This plan must be filed with the EPA on or before September 6, 2016.

Scenarios are a way to model potential future compliance options.

Sensitivities determine how one variable (such as high gas price) may be affected by changes in another variable (such as high energy efficiency).

The scenarios consist of four (4) model runs with various sensitivities applied on each scenario. The scenarios are:

(1) A case assuming a rate-based compliance strategy, with 4 sensitivities for high load growth, high gas price, high energy efficiency and high coal retirements;

(2) A case assuming a mass-based compliance strategy and with the new source compliment and regional trading, with 3 sensitivities for: high gas price, high energy efficiency and high coal retirements

(3) A case assuming a mass-based compliance strategy without the new source compliment that assumes regional trading, with 4 sensitivities for: high load growth, high gas price, high energy efficiency and high coal retirements.

(4) A case assuming a mass-based compliance strategy without the new source compliment that assumes regional trading and output based allocation including "set-asides" which mirror EPA's Federal model rule, with 3 sensitivities for: high gas price, high energy efficiency and high coal retirements.

Modeling results are expected in the mid-March.